SSVEO IFA List **Date:02/27/2003**

STS - 52, OV - 102, Columbia (13) **Time:04:13:PM**

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:10:20.993	Problem	**FIAR**	**IFA** STS-52-V-01	RCS
PROP-01	**GMT:** 296:17:20:00.000		**SPR** 53RF01	**UA**	**Manager:**
			IPR	**PR** FRC2-14-0362	
					Engineer:

Title: F3L Fail-Off and Leak (ORB)

Summary: DISCUSSION: Reaction control subsystem (RCS) primary thruster F3L was declared failed-off on its first attempted firing shortly after External Tank separation. When the fire command was initiated, the thruster chamber pressure remained at 0 psia. Redundancy management (RM) declared thruster F3L failed-off after three consecutive chamber pressure discretes of less than 36 psia. Injector tube temperature profiles indicated fuel flow and no oxidizer flow. Approximately 8 seconds after the thruster failed-off, the oxidizer injector tube temperature began to decay, indicating an oxidizer leak. Thruster F3L was declared failed-leak by RCS RM when the RCS injector tube temperature dropped below 30?F.

After the leak began, repeated freeze/thaw cycles were observed over the next 75 minutes with the oxidizer tube temperature reaching as low as 0?F. During the same time period, the fuel injector tube temperature trended slowly down to about 67?F. This response indicated that the oxidizer leak was small, probably less than 100 cc/hr. Following this 75-minute period, the leak appeared to have healed itself and the oxidizer injector tube temperature rose steadily and reached 58?F during a 45-minute period. At that time, the recovery slowed markedly, perhaps indicating that a very small oxidizer leak had recurred. This condition persisted for about 2 hours, at which time the leak totally healed itself and the oxidizer tube injector temperature fully recovered. The total time from the beginning of the leak to the end was about 3 hours and 55 minutes. The thruster was left deselected for the remainder of the mission, including the RCS hot-fire test. The leak did not recur. CONCLUSION: The most probable cause of the thruster fail-off was iron-nitrate contamination in the oxidizer-valve pilot stage that prevented its proper operation. The subsequent fail-leak was probably caused by some of the contamination being delivered to the pilot-valve sealing surface during the attempted firing of thruster F3L. CORRECTIVE_ACTION: KSC removed and replaced the thruster and transferred it to the White Sands Test Facility for the thruster flush program. Iron-nitrate formation is assisted by the presence of water (moisture) in the oxidizer valve. Therefore, the primary thruster throat plugs are installed during ferry and turnaround to reduce the likelihood of moisture intrusion into the propellant system. Failure analysis results will be documented in CAR 52RF01-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:00:00:20.993	Problem	**FIAR**	**IFA** STS-52-V-02	MPS
BSTR-01	**GMT:** 296:17:10:00.000		**SPR** 53RF02	**UA**	**Manager:**
			IPR 55V-0003	**PR**	
					Engineer:

Title: Engine 2 LOX Inlet Temperature Sensor Failed (ORB)

Summary: DISCUSSION: Data from the main engine (ME)-2 liquid oxygen (LO2) inlet temperature transducer (V41T1231C) became erratic at 6.5 seconds mission elapsed time (MET) and failed off-scale high (-255 degrees F) at 14 seconds MET. The indication remained off-scale high throughout powered ascent and recovered at main engine cutoff (MECO). The indication again failed off-scale high at the end of the main propulsion system (MPS) propellant dump and was regained near the end of the MPS vacuum inerting. The temperature indication was steady throughout the prelaunch period, when it was used to monitor the engine inlet temperature conditions as part of LCC MPS-24.

On the vehicle, standard temperature probe troubleshooting was performed. This included wire wiggles and installation of a breakout box for voltage and resistance checks on the probe. None of these tests could repeat the erratic performance seen during flight. The probe was removed and replaced and sent to Rockwell-Downey for further troubleshooting. Testing at room and cyrogenic temperatures did not repeat the anomaly. The probes are qualified to fly 12 times before an inspection is required and this probe flew 8 times on OV-104 before it was removed, inspected, and installed on OV-102 for STS-50 . This restarted the clock on the number of flights on the probe. STS-52 was the second flight for the probe since inspection, and there was no indication of a problem on STS-50. The probe will be scrapped. CONCLUSION: The most probable cause of the erratic temperature response was an intermittent open in the temperature probe wiring. Inspection indicated that no mechanical failure of the probe occurred. CORRECTIVE_ACTION: Troubleshooting did not repeat the anomaly. The temperature probe was removed and replaced and sent to Rockwell-Downey for further testing. The results of the testing will be tracked under CAR 52RF02. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** -001:18:50:20.993	Problem	**FIAR**	**IFA** STS-52-V-03	EPD&C
EGIL-01	**GMT:** 296:12:00:00.000		**SPR** 52RF04 (FL6),	**UA**	**Manager:**
			52RF05 (FL8)	**PR** DDC-2-14-0055	
			IPR 55V-0002		**Engineer:**

Title: Middeck Floodlights 6 and 8 Failed (ORB)

Summary: DISCUSSION: Prior to crew ingress, middeck floodlights 6 and 8 were non-functional with either the dedicated switch or the emergency lighting switch. (The

lights had flickered and failed off.) Middeck floodlight 6 is located above the port flight-deck access, and middeck floodlight 8 is located above the starboard flight-deck access. The emergency lighting consists of middeck floodlights 6, 8, 7. Middeck floodlight 7 and the five other middeck floodlights were functional. The decision was made to fly-as-is.

CONCLUSION: The middeck ceiling floodlights 6 and 8 were tested at KSC and failed to illuminate. The most probable cause is burned-out bulbs. CORRECTIVE_ACTION: The light assemblies will be sent to NASA Shuttle Logistics Depot for troubleshooting and repair. Further troubleshooting to be tracked by IM 52RF04 and IM 52RF05. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. There is sufficient redundancy in the interior lighting system to handle isolated bulb failures. Bulb operating life is approximately 6000 hours with a light output of at least 60 percent of initial light output.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:08:12:20.993	Problem	**FIAR**	**IFA** STS-52-V-04	PRSD
EGIL-03	**GMT:** 298:01:22:00.000		**SPR** 50RF18	**UA** UA-2-A0015	**Manager:**
			IPR	**PR**	
					Engineer:

Title: PRSD O2 Tank 2 Heater A2 Erratic (ORB)

Summary: DISCUSSION: At approximately 298:01:22 G.m.t., when the oxygen (O2) tank 2 heaters were placed in the auto mode for the crew sleep period, the A2 heater did not indicate "on" until midway through the heater cycle. This phenomenon was previously seen on STS-50 (IFA STS-50-V-05), but it could not be reproduced in ground troubleshooting, and therefore, the heater system was flown as-is. The most likely cause of the problem at that time was thought to be a loose connection in the heater "on" discrete electrical circuitry.

However, during a subsequent STS-52 heater cycle, at approximately 298:03:03:30 G.m.t., when the A2 discrete went to "on" midway through the heater cycle, the fuel cell 3 current ramped up by approximately 7 amperes. This indicated that the heater A2 itself was lagging (not just the discrete), and the ramp up of the current as opposed to the normal step change represented an anomalous activation of the heater. Heater A2 was deactivated for the remainder of the mission, and the O2 tank 2 was depleted using single-heater operations. Troubleshooting at KSC initially recreated the problem and isolated the cause to either of the serial remote power controllers (RPC's) 9 or 10 in the tank 2 heater controller. However, during subsequent troubleshooting to further isolate the problem, the heater lag did not recur. CONCLUSION: The O2 tank 2 heater A2 lag was caused by a problem within either RPC's 9 or 10 in the tank 2 heater controller. CORRECTIVE_ACTION: The O2 tank 2 heater controller has been removed and replaced. The removed unit will undergo failure analysis under the listed CAR. The replaced unit will be verified through OMRSD retest requirements. Even if the problem should recur prior to the completion of failure analysis, the tank can still be utilized with the redundant heater system. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:08:10:20.993	Problem	**FIAR** BFCE-213-F-010	**IFA** STS-52-V-05	GFE
MMACS-03	**GMT:** 298:01:20:00.000		**SPR** None	**UA**	**Manager:**
			IPR None.	**PR**	
					Engineer:

Title: Multimeter Intermittent Display and Low Battery Indication (GFE) (GFE)

Summary: DISCUSSION: At approximately 298:01:20 G.m.t., while the crew was using the Fluke multimeter (S/N 55460298) to measure temperatures, they reported that the multimeter read-out began flashing and the overload indication (potentially low batteries) came on. The crew changed the battery, and this corrected the problem temporarily. However, the multimeter problem recurred intermittently. Information received from the vendor indicated that a pair of capacitators within the multimeter could come in contact with the electromagnetic interference (EMI) shield, causing the capacitators to short-to-ground, resulting in the symptoms voiced by the crew. An in-flight maintenance procedure was executed by the crew to insulate the capacitors; however the problem still persisted on an intermittent basis.

Postflight troubleshooting by the vendor traced the problem to the main integrated chip (U4). The clock within the chip was slow and did not always load the display registers properly at start-up. Once the multimeter completed the self-test successfully, the chip problem could not impair the function of the multimeter. However, if the chip problem occurred during self-test, the multimeter showed the same symptoms seen in-flight. CONCLUSION: The flashing display and overload indications experienced with the Fluke multimeter S/N 55460298 were caused by an intermittent start-up problem within the main integrated chip. CORRECTIVE_ACTION: The entire circuit board containing the main integrated chip has been removed and replaced in S/N 55460298. The removed circuit board will be tested at the vendor to further characterize the failure mode. The flight equipment processing contractor has implemented a preflight test of each multimeter to screen out subsequent recurrences of this start-up problem. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:17:20:20.993	Problem	**FIAR**	**IFA** STS-52-V-06	FCP
EGIL-02	**GMT:** 297:10:30:00.000		**SPR** 52RF03	**UA**	**Manager:**
			IPR	**PR** FCP-2-14-0257	
					Engineer:

Title: Fuel Cell 1 Cell Performance Monitor Hang Up (ORB)

Summary: DISCUSSION: At approximately 297:10:25 G.m.t., after the fuel cell 1 cell performance monitor (CPM) completed a self-test, its substack 3 delta voltage went to 44 mV and then later transitioned to the 36 mV reading for varying durations after each subsequent self-test before returning to 36 mV. At 297:11:30 G.m.t., the

substack 3 reading transitioned to 44 mV after every self-test. As the mission progressed, the substack 3 reading slowly increased to 60 mV. Since the CPM could not reliably detect cell problems within substack 3, main busses A and B were cross-tied so that the difference in current between fuel cells 1 and 2 could be used to detect cell problems within fuel cell 1.

This same CPM unit (S/N J346) flew on STS-51J and STS-61B, where it exhibited similar behavior (IFA STS-61B-09). After STS-61B, the CPM was removed and replaced. The failure could not be duplicated during failure analysis; however, the circuit card for the substack 3 measurement was replaced. This CPM was reflown on STS-29, STS-33, and STS-50 with no anomalous behavior. Failure analysis performed at the vendor after STS-52 also could not duplicate the problem. CONCLUSION: The cause of the hang up in the CPM S/N J346 substack 3 delta voltage reading is unknown. This behavior has not been seen on any other CPM. CORRECTIVE_ACTION: The CPM has been removed and replaced on OV-102. All of the components of the CPM S/N J346 that affect the substack 3 measurement (power supply card feeding all 3 measurements, substack 3 measurement card, motherboard, substack 3 measurement input and output connectors, and the electromagnetic interference filter on the output connector) will be removed and replaced. CPM J346 will be reacceptance tested and returned to the flight inventory. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:19:50:20.993	Problem	**FIAR**	**IFA** STS-52-V-07	OMS
PROP-02	**GMT:** 298:13:00:00.000		**SPR** 52RF06	**UA**	**Manager:**
			IPR 55V-0004	**PR**	
					Engineer:

Title: ROMS GN2 Low Pressure System Leak (ORB)

Summary: DISCUSSION: The right orbital maneuvering engine (OME) GN2 low pressure system experienced a slow leak throughout the STS-52 mission. The low pressure system is monitored by sensor V43P5549C, which is located upstream of the GN2 accumulator and is typically referred to as the accumulator pressure. The leak was first noticed following the OMS-2 burn and the leak rate was approximately 80 scch. The OMS-3 and OMS-4 burns were performed 16 minutes apart and after the OMS-4 burn, the leak rate was about 100 scch. Following these burns, the system was repressurized prior to each crew sleep period to protect against violations of the 299-psia fault detection and annunciation (FDA) limit and the accompanying alarm. The leak rate following each of these repressurizations was about 50 scch. After each repressurization, the accumulator pressure remained at approximately 335 psia for about 8 hours until the pressure began to decay. This delay is the result of the high pressure trapped between the isolation valve and the regulator until the pressure decays below the regulator setpoint. Note that a pressure of 283 psia is required to ensure that the OME ball valves will open in the event of a failed-closed isolation valve. Therefore, the capability to operate the engine was available at all times and the leak did not impact the mission.

STS-52 was the second flight of both the right OMS pod (RP05) and the right OME (S/N 116). A review of STS-50 flight data, the first flight of the pod and the OME indicated that the performance of the right OME GN2 low pressure system was within specification. Troubleshooting included a mass spectrometer leak check of the right OME low pressure system using GHe as well as pressure decay tests using GN2 at 350 psi both prior to and after cycling the engine control valves. There was no out-of-specification leakage indicated during any of these tests. The most probable cause of the leak was transient contamination at one of the two engine control valves. The contamination could have been cleared during deorbit burn. Another possibility is contamination of the engine purge valves. This is considered to be less likely since the valves are in series and would therefore require the leakage of both valves. CONCLUSION: The right OME GN2 low pressurizaton system experiences a slow leak throughout the STS-52 mission and repressurization once every 24 hours were sufficient to maintain system pressure above the 299-psia FDA limit. The most probable cause of the leak was transient contamination at one of the two engine control valves. Troubeshooting of the systems was unable to reproduce the leak. CORRECTIVE_ACTION: The right OME GN2 low pressure system was leak checked and no out-of-specification leakage was identified. The engine will be flown as-is. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Should a leak of the magnitude seen recur, it can be managed by periodic repressurizations as were performed on STS-52.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 000:16:40:20.993	Problem	**FIAR** A) JSC EE-0676F	**IFA** STS-52-V-08	GFE
INCO-04, 03	**GMT:** 297:09:50:00.000		B) JSC EE-0677F	**UA**	**Manager:**
			SPR None	**PR** COM-2-14-0236	
			IPR		**Engineer:**

Title: TAGS A) Developer Motor FailB) False Jam Indication (GFE)

Summary: DISCUSSION: A) On flight day 7, the first page of the morning mail was jammed in the text and graphics system (TAGS) hardcopier. The TAGS malfunction procedure was performed, but TAGS operation was not regained, and the unit was turned off since the jam apparently could not be cleared. The crew was requested to reactivate the TAGS about 15 minutes later and after further troubleshooting, the jam was cleared and the TAGS began operating. The TAGS experienced a second jam during flight day 7 operations. The upper booster rollers were not turning and this indicated a developer motor problem. The TAGS was deemed usable for periodic operations after being powered off for a period of time; however, a decision was made to use the TAGS only in the graphics mode for the remainder of the mission with the text being transmitted via the teleprinter.

Postflight analysis of the developer assembly revealed that, when the unit is at operating temperature, the center-paper deflector contacts the metal developer drum. Further analysis shows that, external to the developer, the lower paper guide is protruding through the bulkhead and contacting the developer faceplate. This protrusion is about 0.005 inch and when the developer is installed into the unit, the gap between the scraper and drum closes an undetermined amount. There is a 0.004-inch gap requirement between the guide and the drum at cool-temperature conditions. As the TAGS is used, the temperature increases and the gap closes. In this case, the gap closed to the point where the center-paper deflector was pushed against the developer drum by the lower paper guide. This was the first flight of this unit (serial number 008). Although

this unit passed its functional testing, it did not have the usage required to detect the developer assembly anomaly noted. B) A TAGS hardcopier false jam indication occurred upon TAGS activation. The indication was expected, and the crew should normally advance the TAGS to clear the indication. However, the crew stopped working the activation procedure, thinking the TAGS was jammed. An advance command was sent from the ground clearing the jam indication, and the TAGS operated properly until uplink of the morning mail on flight day 2 when a second false jam indication was received. The indication was cleared when the crew pressed the advance key. This condition was intermittent and did not physically jam the unit. Two additional TAGS false jam indications were annunciated during transmittal of the morning mail on flight day 5. The cause of these false indications is believed to be a faulty paper sensor in the lower paper path. In the last two cases, TAGS operations were again regained by transmitting an advance command. Postflight troubleshooting included an electroincs check. The results showed no anomalous conditions in the lower paper path sensor, however, the sensor was operating on the outer limits of its voltage specification requirements of 8-volts minimum for paper present and 2-volts maximum for no paper. The unit would detect paper but with the lower voltage present at times, the sensor would not detect the paper soon enough. This delay in detecting the paper jam caused a time out of the JAM detection software and the JAM indication was asserted. CONCLUSION: A) The drag of the deflector against the roller drum caused a significant increase in the torque required to turn the drum and subsequently caused the developer motor to stall. B) The lower paper path sensor was operating on the outer limits of its voltage/time specification requirements and caused the false indications noted on this unit. CORRECTIVE_ACTION: A) The paper guide that caused this problem has been properly adjusted. The developer motor will be replaced since damage occurred as a result of it being overstressed. Once the repairs are made, this unit will be tested to ensure it is operational. There are 3 other units in the field. One has been specifically tested for this condition. The other two units will be examined as the units are processed for routine maintenance. B) The lower paper path sensor has been optimized to be more sensitive to paper detection. EFFECTS_ON_SUBSEQUENT_MISSIONS: A) None. B) None. It is not expected that the intermittent false jam indications would recur, but should this problem recur, TAGS operations are easily regained by the ground transmitting an advance command. The ground is able to detect the false jam indications, and therefore, can quickly uplink the advance command.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:06:12:20.993	Problem	**FIAR**	**IFA** STS-52-V-09	EPD&C
EGIL-04	**GMT:** 302:23:22:00.000		**SPR** None	**UA**	**Manager:**
			IPR 55V-0005	**PR**	
					Engineer:

Title: Panel A11 Main C DC Utility Outlet Failure (ORB)

Summary: DISCUSSION: At approximately 302:23:21 G.m.t. (006:06:12 MET), the crew reported that the Main C utility power outlet on panel A11 was inoperable when using the Linhof camera. The Linhof was operational in panel MO30F. The heat pipe performance payload was operated at 302:17:54 G.m.t. (006:00:45 MET) and this was the last known time the outlet was operable. The utility outlet on panel A11 shares a common circuit braker (cb 9) with utility power outlets on panels MO30F and A15. Utility power outlet A15 was in use with the portable audio data modem at the time the failure was reported. This clears cb 9 as being the cause of the problem. At 302:33:49 G.m.t. (006:16:40 MET), a preflight-approved in-flight maintenance (IFM) procedure was performed to determine if the loss of power was in the outlet. Normal

voltages were measured. The crew reported that the outlet did not appear to have recessed pins and the Linhof was again plugged into the panel A11 outlet. Although the outlet was operational, it was suspect and not used for the launch/entry suits during entry.

CONCLUSION: Troubleshooting at KSC verified that the outlet pins were locked in place and not recessed. The utility power outlet on panel A11 was functional. Troubleshooting performed on the Linhof cable did not reveal any anomalous conditions. The cable will be downgraded for training because there is a need for a training cable. The most probable cause of the failure is improper mating of the cable to the outlet. The cable connector is a quick disconnect where it has to be pushed in and clicked to the right as far as possible to properly seat. CORRECTIVE_ACTION: There are no hardware changes to be made. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Should this recur, the steps detailed in the Discussion would be followed.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 006:21:21:20.993	Problem	**FIAR**	**IFA** STS-52-V-10	C&T
INCO-06	**GMT:** 303:14:31:00.000		**SPR** 52RF07	**UA**	**Manager:**
			IPR	**PR** COM-2-14-0237	
					Engineer:

Title: S-Band FM Transmitter 1 RF Output Power Erratic (ORB)

Summary: DISCUSSION: The FM transmitter output power fluctuated from a nominal 16 watts to a low of approximately 10.9 Watts during the mission. This condition had been observed on the previous mission but not with this amount of fluctuation. Although the output power remained above the specification limit of 10 Watts and no degradation of the data was reported, the signature of the power fluctuations appeared to be becoming progressively worse. Mission control personnel switched the S-Band FM to Transmitter 2 for the remainder of the mission and operation was nominal.

CONCLUSION: The noted power fluctuation is indicative of a transmitter 1 failure. CORRECTIVE_ACTION: Transmitter 1 was removed and replaced at KSC. The anomalous transmitter has been sent to the vendor for failure analysis and the failure was confirmed. Any further troubleshooting and results will be tracked by IM 52RF07. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 001:08:52:20.993	Problem	**FIAR**	**IFA** STS-52-V-11	C&T
INCO-01	**GMT:** 298:02:02:00.000		**SPR** 52RF13, 52RF14	**UA**	**Manager:**
			IPR 55V-0006	**PR**	

Engineer:

Title: S-Band PM Low Frequency Loss-of-Lock (ORB)

Summary: DISCUSSION: On orbits 20W, 22W, 23W, 24W, 26W, 26E, and 27W, while using the tracking and data relay satellite (TDRS) in the low frequency mode, the S-band phase modulation (PM) system could not maintain a forward link from the TDRS. This problem was present on all antennae and both TDRS satellites. Switching to string 1 onboard or selecting an alternate chain of ground equipment at White Sands did not correct the problem. When the frequency was switched from low to high, the communications became nominal. As a result of this condition, the S-band PM system was operated in the high frequency mode, and no further unusual losses of lock occurred. Later in the mission, troubleshooting confirmed that the problen was related only to the use of the S-band PM system in low frequency. Although the problem initially took eight hours to occur, it repeated within minutes during the troubleshooting. The frequency mode was used for the remainder of the mission.

The on-orbit troubleshooting isolated the problem to the S-band preamplifier, the S-band switch assembly, or the coaxial cable between the preamplifier and the antenna switch assembly. KSC troubleshooting isolated the problem to the coaxial cable connector at the antenna switch assembly. A temperature of 260?F was measured on the outside of the connector; the nominal is less than 140?F. The low frequency was not required for this mission. For some missions, the use of low frequency is required to avoid interference with payload communications systems. A specific example is the Hubble Space Telescope which uses the same frequencies as the Orbiter in high frequency. CONCLUSION: The problem is a faulty coaxial cable. CORRECTIVE_ACTION: The coaxial cable and the antenna switch assembly have been removed and replaced. The cable was sent to Rockwell/Downey for failure analysis. The antenna switch assembly has been sent to the vendor to determine if the excessive temperature caused any damage to the mating connector. Further analysis and troubleshooting will be tracked by IM 52RF13 for the coaxial cable and IM 52RF14 for the switch assembly. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 007:23:55:20.993	Problem	**FIAR**	**IFA** STS-52-V-12	ECLSS
EECOM-02	**GMT:** 304:17:05:00.000		**SPR** 52RF11	**UA**	**Manager:**
			IPR 55V-0014	**PR**	

Engineer:

Title: FES Feedline A Forward Heater System 2 Failed. (ORB)

Summary: DISCUSSION: At approximately 304:17:00 G.m.t., the flash evaporator system (FES) feedline A temperature (V63T1870A) dropped below the normal setpoint temperature. By 304:18:42 G.m.t., the temperature had dropped to 50?F, triggering a fault detection and annunciation message. At that point, the system 2 heater was turned off and the redundant system 1 heater was activated. The system 1 heater maintained accepatable temperatures for the remainder of the flight.

Troubleshooting at KSC revealed that the thermosatat for this heater (40V63S10) would not close when chilled below its setpoint. CONCLUSION: The FES feedline A forward heater system 2 failed because the thermostat failed to close. CORRECTIVE_ACTION: The thermostat has been removed and replaced. The removed thermostat will undergo failure analysis under the listed CAR. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 009:17:18:20.993	Problem	**FIAR**	**IFA** STS-52-V-13	RCS
PROP-03	**GMT:** 306:10:28:00.000		**SPR** 52RF08	**UA**	**Manager:**
			IPR 55V-0007	**PR**	
					Engineer:

Title: FRCS Fuel Manifold 3 Microswitch Closed Indication Failed-On (ORB)

Summary: DISCUSSION: During the deorbit-preparations time period, at 306:10:28:02 G.m.t., the forward reaction control subsystem (FRCS) manifold-3 fuel-isolation valve closed microswitch (V42X1329X) failed-on indicating that the valve had closed. At the same time, the fuel valve open microswitch (V42X1328X) and the manifold 3 oxidizer valve open (V42X1228X) and closed (V42X1229X) microswitches continued to indicate that the manifold-3 fuel and oxidizer valves were open. The crew reported that the onboard indication on panel O8 remained "open", whereas the talkback would have indicated barberpole had an actual mismatch in valve position occurred. Other data, including the valve cockpit switch position indication and the forward motor controller assembly (FMCA) 3 operational status indications, showed that both valves were open.

Following the FRCS propellant dump, the manifold isolation valves were closed and the manifold-3 fuel-isolation valve closed nominally. Postlanding, when the manifold isolation valves were opened, the manifold-3 fuel-isolation valve appeared to lag the oxidizer valve by 1 second. However, this is not conclusive because of the sample rate of the data (1 sample/second). Note that all valve-position indications were correct when the valves were closed following the FRCS propellant dump and when they were reopened postlanding. Ground troubleshooting included cycling the valves 10 times and the anomaly did not repeat. It is suspected that the problem was caused by contamination in the limit switch. This failure mode has been seen in the past and the condition is manifested during zero-g when contaminants drift into the contact areas of the switch. The corrective action for the conditon was to conduct particle-induced noise detection (PIND) tests on all switches prior to their installation into the actuator assembly. This was an older-configuration actuator which contained non-PIND tested limit switches. All new and refurbished actuators contain PIND-tested switches. CONCLUSION: The most probable cause of the anomaly was contamination in the actuator limit switch module. This condition has been seen in the past with non-PIND tested switches. CORRECTIVE_ACTION: The FRCS manifold-3 fuel-isolation valve actuator was removed and replaced with an actuator with a PIND-tested switch. Upon removal, the actuator was shipped to the vendor for failure analysis. Results of the failure analysis will be tracked under CAR 52RF08-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 009:20:22:20.993	Problem	**FIAR**	**IFA** STS-52-V-14	D&C
GNC-01	**GMT:** 306:13:32:00.000		**SPR** 52RF09	**UA**	**Manager:**
			IPR 55V-0010	**PR**	
					Engineer:

Title: Surface Position Indicator Failed Off (ORB)

Summary: DISCUSSION: Shortly after the transition to major mode 304, the Commander reported that the surface position indicator (SPI), serial number (s/n) 8 OFF flag was present and all SPI indicators were non-operational. The crew cycled the instrument power once and recovered the SPI. After 6 minutes, the OFF flag reappeared and the crew reported that only half of the SPI indicators were working.

Postflight testing performed while the SPI was still installed in the vehicle did not recreate the failure. The unit was sent to NASA Shuttle Logistics Depot (NSLD) for testing, including thermal testing and internal visual examination. The failure could not be duplicated and no discrepancies were noted. However, during thermal testing and off-nominal voltage testing, minor anomalies occurred that are not believed to be related to the in-flight anomaly (small intermittent oscillations and minor scale-offset on one indicator). The scale-offset was caused by a zener diode and a feedback potentiometer that were both replaced, and this corrected the problem. The minor oscillations will also be corrected. Testing will continue under CAR 52RF09. If the failure is not recreated, an acceptance test procedure (ATP) will be performed on the unit, and will include vibration testing. If the unit passes ATP and vibration testing, it will be sent to Shuttle Avionics Integration Laboratory (SAIL) for confidence testing. CONCLUSION: The most likely cause is a power supply problem within the SPI since the original problem affected more than one channel. CORRECTIVE_ACTION: The SPI, s/n 8, has been removed and replaced with s/n 5. Troubleshooting and corrective action will continue under CAR 52RF09. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Should the failure recur, the crew would use cathode ray tube (CRT) displays as an alternate source of information.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 009:19:49:20.993	Problem	**FIAR**	**IFA** STS-52-V-15	GFE, INST
INCO-07	**GMT:** 306:12:59:00.000		**SPR** None	**UA**	**Manager:**
			IPR 55V-0012	**PR**	
					Engineer:

Title: OEX recorder tape position indicator dropped during entry (RMS)

Summary: DISCUSSION: During the STS-52 flight, prior to entry interface at 306:12:58:00 G.m.t., the System Control Module (SCM) component of the Orbiter Experiments/Modular Auxiliary Data System (OEX/MADS) erroneously reset the percent-tape-used indication from 12 percent to 2 percent.

Postflight troubleshooting on OV-102 consistently repeated the problem whenever the OEX recorder was powered up by the SCM. Monitoring of the beginning-of-tape (BOT) voltage level from the OEX tape recorder to the SCM revealed that the OEX tape recorder was sending a premature BOT voltage to the SCM. This resulted in a reset (zero) of the percent-tape-used indication. Analysis showed that the internal SCM counter reset when the OEX recorder (s/n 1001) was powered up by the SCM. The tape itself was repositioned, only the indication was reset. At JSC, the SCM engineering unit and OEX recorder s/n 1002 were configured and tested for this problem. The failure could not be repeated and therefore, is not considered to be a generic problem. CONCLUSION: The problem is a percent-tape-used indication problem and is unique to OEX recorder s/n 1001. CORRECTIVE_ACTION: Due to the unavailability of a spare OEX recorder, this unit will remain installed on OV-102 and will fly again on STS-55. Procedures are being generated to manually record "tape used" during STS-55 operations. KSC will remove and replace the recorder after STS-55, and return the recorder to JSC for failure analysis. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** Post-flight	Problem	**FIAR**	**IFA** STS-52-V-16	MECH
None	**GMT:** Post-flight		**SPR** 52RF10	**UA**	**Manager:**
			IPR	**PR** MEQ-2-14-0509	
					Engineer:

Title: Right Inboard Rotor 2 Bushing Damage. (ORB)

Summary: DISCUSSION: Weather conditions at the landing site for STS-52 were observed at the time of landing to be: temperature 78?F, winds from 088 degrees true at 6 knots gusts to 9 knots, and barometric pressure of 30.06 in. Hg.

Brake energies were low with maximum brake pressures on the right inboard brake of 984/840 psi and 960/924 psi for right outboard. The brake pressures averaged approximately 600 psi. The calculated brake energies for the right brake were 18.87 M ft-lb for the inboard and 17.9 M ft-lb for the outboard (qualified for 82 M ft-lb). The brakes are certified for multiple landings up to 45 M ft-lb. The vehicle landing weight was estimated to be 216,176 lb. Brakes were applied at 101.1 kts ground speed. The postflight inspection of the carbon brakes revealed the right-hand inboard brake (serial number 0029) was observed to have apparent melting of the retainer drive clip rivet bushings on rotor 2. The hardware was sent to the vendor for teardown analysis and evaluation. During teardown analysis, the vendor found the rotor 2 pressure plate side had five bushings showing the very beginning of melting. The back plate side had 17 bushings with melting evidence. The melting is under the sweep area of the corresponding stator with the depth of the melt approximately 0.030 in. Rotor 3 also had 18 bushings showing evidence of the initiation of melting. The other components of the brake stack were within specifications. The melting experienced is theorized to be a result of local rotor/stator contact producing instantaneous heating concentrated on the contacting surfaces. This condition is a known phenomena on carbon brakes and has been observed on test hardware and other carbon brakes in the field. Through analysis and testing, the vendor has determined that the brake functional capability is unaffected by the flash heating effects and the melting in the observed areas should be expected on future flights. CONCLUSION: The observed conditions can be expected on future flights and is not a constraint to re-use for carbon brakes. CORRECTIVE_ACTION: Future flight disposition for this conditon is to fly-as-is. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 009:12:16:20.993	Problem	**FIAR**	**IFA** STS-52-V-17	ECLSS
EECOM-03	**GMT:** 306:05:26:00.000		**SPR** 52RF12	**UA**	**Manager:**
			IPR	**PR** ECL-2-14-0872	
					Engineer:

Title: WCS Fan Sep 1 Shutdown (ORB)

Summary: DISCUSSION: During STS-52 deorbit preparation, as the crew was starting fan separator (fan sep) 1 to use waste collection system (WCS) serial number (s/n) 500, the fan sep stopped running suddenly. Normal startup and run currents were noted in the downlink, and no evidence of stalling was noted in the data. The data indicated that the ac power dropped suddenly. The crew reported that fan sep 1 had been noisy during the last day of use. No troubleshooting was done on fan sep 1 since the failure occurred on entry day. Fan sep 2 was used for the remaining four hours of the mission.

Postlanding, KSC personnel reported that fan sep 1 started normally. However; once the unit was returned to the vendor, it was powered up and did not operate. Upon futher investigation, it was determined that start up at the vendor did not have the same signature as the in-flight failure. At the vendor, stall currents were seen. This problem was due to urine salts drying during the time period between KSC testing the unit and the time the vendor tested the unit. Once the fan sep was pushed to break the urine salts, the fan sep ran fine. This explains why the fan sep worked at KSC, but later would not run at the vendor. The most likely cause of the in-flight failure was an intermittent dc power loss to the fan sep ac power relay, which would cause the observed signature. This is the only single-point failure that would cause all three ac currents to drop. There is a dc circuit breaker in the vehicle which provides power to the WCS. In the WCS, there are two switches which must be activated to a thermal switch which will open at 248?F which, if open, would result in the observed signature. All of these switches have been scrutinized and tested at the vendor, as were the soldered joints and electrical connectors. No anomalous condition was found. A problem in Orbiter wiring could have caused the loss of dc power. However, this wiring was tested postlanding with WCS s/n 500. Fan sep 1 started normally. Additionally, the WCS to be used on the next flight of OV-102 has been installed and no anomalous condition was found during test and checkout. CONCLUSION: The most likely cause of the failure is an intermittent dc power loss to the fan sep ac power relay. The dc power loss to the relay would cause ac power to drop suddenly, which is the signature observed in-flight. CORRECTIVE_ACTION: The fan sep was removed from the WCS and cleaned. Testing will continue under CAR 52RF12. As part of normal turnaround activity at the vendor, this fan sep was removed and replaced. Switches, soldered joints amd electrical connectors were tested and visually scrutinized as part of the normal WCS turnaround. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. In the event that the fan sep fails on a future mission, there are switches to bypass the microswitches and supply dc power directly to the relay. In addition, an alternate fan sep is available for use with the WCS, as well as contingency waste collection devices.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 009:19:11:20.993	Problem	**FIAR**	**IFA** STS-52-V-18	HYD,TCS

MMACS-04 **GMT:** 306:12:21:00.000 **SPR** 52RF15 **UA** **Manager:**

IPR **PR** HYD-2-14-0595(6)

Engineer:

Title: Left Main Gear Outboard Heater Overtemperature (ORB)

Summary: DISCUSSION: At approximately 306:11:10:17.414 G.m.t., the landing gear brake heaters were turned on for entry/deorbit preparation. The hydraulic port outboard brake line temperature sensor V58T1702A began to rise to a temperature of 231?F. This temperature rise spanned a period of 1 hour, 18 minutes and 31 seconds, at which time the landing gear brake line A heaters were turned off to prevent exceeding an agreed upon upper limit of 250?F. The landing gear circuitry including brakes are not certified above 275?F.

This heater overtemperature condition was witnessed on the previous flight of this vehicle (STS-50). Postflight at KSC, the V59T1702A temperature sensor was relocated further from the heater to meet drawing requirements. The rework, however, did not alleviate the problem. A similar overtemperature condition was also noted on OV-105's right main gear brake lines during STS-47. The hydraulic brake line, which experienced the overtemperature condition on STS-50 and STS-52, was modified during the Orbiter maintenance down period and shortened by 20 inches. The heater, however, was not shortened but was reinstalled and rewrapped with aluminized Kapton tape instead of the black Kapton tape called out on the drawing. The shortening of the hydraulic line reduced the energy absorbing area while the heater size remained the same. In addition, the thermal properties of the aluminized Kapton contain the energy from the heater more efficiently than the black Kapton tape. These factors combined to result in a higher line temperature. The Kapton tape configuration of all the vehicles have been determined. OV-102 hydraulic brake lines were rewrapped per specification with black Kapton. It will fly in this configuration for STS-55. The STS-55 flight will verify the analysis and help to determine if the change in Kapton will prevent excessive temperatures without a modification to shorten the heater wrap. OV-103 is being reconfigured per a Kennedy Space Center Problen Report; it had only one line that required retaping. OV-105 has eight hydraulic lines that need to be rewrapped with the black Kapton tape, it will fly in this configuration for STS-54. OV-104 is in major modification and will be rewrapped with black Kapton tape. The main landing gear brake line heater system was designed to thermally condition the hydraulic fluid in the hard and flex lines to an average viscosity weight temperature of -20?F prior to the first braking application. The heaters are composed of three redundant heater systems and each of the three independent heaters (A,B,& C) is capable of raising the average viscosity weighted fluid temperature to -20?F prior to deorbit. Currently, the three brake line heater systems are turned on 1 hour 55 minutes prior to the deorbit burn regardless of brake line temperatures which in most cases are in the 20?F plus range at activation and 75-100?F at touchdown. CONCLUSION: The shortening of the hydraulic line reduced the energy absorbing area, while the heater size remained the same. In addition, the thermal properties of the aluminized Kapton contain the energy from the heater more efficiently than the black Kapton tape. These factors combine to result in a higher line temperature. CORRECTIVE_ACTION: The brake lines in the left and right wells of all vehicles will be rewrapped with the specification black Kapton tape, if required. Subsequently, the heater on the modified left brake line will be shortened or replaced if the STS-55 flight experiences excessive temperatures. The Mission Operations Directorate monitor the heater system during deorbit preparation and entry to ensure that the 250?F temperature is not violated. A crew procedure change is being developed to delete the step to turn on the heaters in the Deorbit Preparation Entry Forward Deck Configuration procedures. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:** 005:05:05:20.993	Problem	**FIAR**	**IFA** STS-52-V-19	GFE
INCO-05	**GMT:** 301:22:15:00.000		**SPR**	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: Camcorder Video Interface Unit (VIU) Anomaly (GFE)

Summary: DISCUSSION: Horizontal lines were noted in the downlinked camcorder video when using camcorder VIU S/N 1009. The crew changed to another VIU and the lines disappeared.

CONCLUSION: Postflight troubleshooting and analysis concluded that the horizontal lines were noise, probably caused by a defective filter. CORRECTIVE_ACTION: Remove and replace discrepant VIU. The discrepant VIU has been returned to JSC for failure analysis and repair. EFFECTS_ON_SUBSEQUENT_MISSIONS: No mission impact.